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THE PECULIARITY OF MUSHROOM IN THE CAMPUS FOREST OF IPB UNIVERSITY

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Abstract: Despite Indonesia's rich biodiversity, information regarding the diversity of macrofungi remains notably limited. This gap underscores the urgent need for more comprehensive and systematic exploration of fungal species across a variety of ecosystems. One particularly underexplored habitat is the campus forest, which has received minimal attention in fungal diversity assessments to date. This study aims to explore and identify fungi in the Campus Forest Area of IPB University. The collection of specimens was carried out in February 2023 using an opportunistic sampling method. The fruiting bodies found were documented in situ, stored as herbarium, and morphologically characterized. Morphological identification was carried out using fresh fruiting bodies samples. The identification results showed five unique fungi from the study site including: *Cookeina tricholoma* (bowl mushroom), *Agaricus* sp. (wild button mushroom), *Cyathus striatus* (bird's nest mushroom), *Marasmiellus* sp. (white toadstool), and Lepista sordida (purple mushroom). The five fungi are saprobes and three of them (*C. tricholoma*, *L. sordida*, and *Marasmiellus* sp.) are edible wild mushrooms. Four of the mushrooms found are Basidiomycota, and one mushroom (*C. tricholoma*) is Ascomycota. The results of this study add data on the diversity of fungi from campus forests in Indonesia as a basis for their further utilization in the future.
Key words: Ascomycota, Basidiomycota, description, identification, taxonomy

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Fungi are categorized as the second largest biotic community after insects. Hawksworth and Lücking (2017) estimate that fungi comprise approximately 2.2-3.8 million species worldwide. These fungi play a crucial role in broader natural ecosystems, serving as decomposers and a food source for animals (Tan et al. 2015). Additionally, fungi are known for their richness in bioactive compounds that have significant health impacts (Fung et al. 2017). Research on the bioactive compound β-glucan found in fungal cell walls can focus on modulating the human immune system due to its antimicrobial, antitumor, antiviral, and hepatoprotective properties (Patel, 2021). Fungi are also utilized in various industries, such as cheese, beer, wine, and bread production (Usman, 2020).

In recent decades, the study of fungal diversity and utilization has become highly significant in Indonesia. However, as of 2017, only 2273 species of fungi (both macro and micro) had been recorded in Indonesia (LIPI, 2019). Inventorying fungal diversity is a preliminary step in their utilization efforts. The utilization of fungal diversity in campus forests can serve as a reference for lectures and practical activities to accelerate the development of mycology in Indonesia. From a mycological perspective, the diversity of macrofungi in Indonesia is still not widely known and understood (Putra et al. 2019), despite fungi being cosmopolitan organisms that can be found in various habitat types.

Institut Pertanian Bogor (IPB) campus forest is a potential habitat for fungal growth due to its dense vegetation and humid environmental conditions (Putra et al. 2020). The forest is dominated by trees, resulting in a significant amount of decaying litter on the forest floor. The extensive campus forest and high rainfall make it an ideal place for fungal development (Putra et al. 2020). Previous studies on fungal diversity in the IPB campus forest have not included descriptions of microscopic morphological characteristics (Putra et al. 2020). Consequently, many fungi in the IPB campus forest have not been identified to the species level. Therefore, this study aims to identify fungi using both macroscopic and microscopic morphological characteristics in the IPB campus forest area, West Java, Indonesia.

METHOD

Study area

This research was conducted in February 2023 in the campus forest (Figure 1) of Bogor Agricultural University (IPB) (-6.5489651,106.7199814) in West Java, Indonesia. The IPB campus spans a total area of 250 hectares, with the forested section occupying 25 hectares.

Sample Collection

Fungi collection was conducted using the opportunistic sampling method as described by O'Dell et al. (2004). The fungi were collected by gathering entire fruiting bodies and documenting them at the research location. Each sample was labelled with the collection date, color, habitat, and a sequential number, then stored in jars containing alcohol for wet herbarium purposes and morphological identification.

Fig. 1. Research location (Yellow line)

Macroscopic and Microscopic Identification of Macrofungi

The macroscopic morphological characteristics of the fruiting bodies were observed based on Putra (2021), including growth patterns, fruit body shape, color, cap shape, cap surface, cap edge, cap margin, moisture level, and hymenophore type (lamellae, pores, teeth). Other observed characteristics included stalk shape, stalk color, stalk surface, attachment position on the cap, type of attachment on the substrate, partial veil, universal veil, and fruit body texture. The samples were then taken to the Integrated Research Laboratory of the Biology Department at IPB for microscopic characterization of spores (color, shape, size), basidia, hyphae, pileipellis, and cystidia.

Data analysis

The obtained macroscopic and microscopic descriptions were used as references for morphological identification using reference books and related literature for each collected fungal genus/species.

RESULTS AND DISCUSSION

The identification results confirmed the presence of five types of fungi in this study: *Cookeina tricholoma*, *Agaricus* sp., *Cyathus striatus*, *Marasmiellus* sp., and *Lepista sordida*. Four fungi belong to the Basidiomycota group (*Agaricus* sp., *C. striatus*, *L. sordida*, and *Marasmiellus* sp.) and one fungus belongs to the Ascomycota group (*C. tricholoma*). Each fungus has distinct morphological characteristics. Below is the taxonomic information and morphological characteristics of the fungi collected in this study.

Taxonomy

Cookeina tricholoma (Mont.) Kuntze, Revisio generum plantarum 2: 849 (1891)

Synonyms:

Cookeina tricholoma (Mont.) Kuntze, Revisio generum plantarum 2: 849 (1891)

Peziza tricholoma Mont., Annales des Sciences Naturelles Botanique 2: 77, t. 4:2 (1834)

Pilocratera tricholoma (Mont.) Henn. (?)

Trichoscypha tricholoma (Mont.) Cooke, Syll. fung.: 160 (1889)

Lachnea tricholoma (Mont.) Pat. & Gaillard, Bulletin de la Société Mycologique de France 4 (3): 98 (1889)

The fruiting bodies of the fungus grow on dead wood, either in clusters or solitary. The apothecia are cupulate, fleshy, and smooth, with a height of up to 2 cm and a width of 1-2 cm (Figures 2a-b). The ascomata are cup-shaped, pink when fresh, and slightly orange, surrounded by compound hairs or fine hairs (tomentose) up to 2 cm wide (Figures 2a-b). The stipe is pink, surrounded by stiff, bristle-like tomentose hairs (Figures 2a-b). The asci are unitunicate, operculate, and cylindrical with a diameter of 9.36 µm, hyaline (Figure 2d). The ascospores are uniseriate, one-celled, oval, hyaline, aseptate, with 2 oil drops and pale yellow, 12.848 µm wide (Figures 2e and circled in black). The ascus encases the spores in a sac called the ascospore. The apothecium is pale yellow-brown, circular, consisting of several asci (Figure 2c).

The results of this study complement the morphological characteristics of the ascus of *C. tricholoma*, which were previously not described by Putra et al. (2019) and Hermawan et al. (2022) in the IPB Campus Forest. This study also confirms the presence of *C. tricholoma* as part of the species monitoring activities from 2019 to 2023 in the IPB Campus Forest. The *C. tricholoma* in the IPB Campus Forest has characteristics similar to the specimens reported by Ekanaya et al. (2016) collected from Thailand. *C. tricholoma* typically has a cup shape, pink to reddish color, and prominent hairs on the surface of the ascomata. *Cookeina* sp. showed cellulolytic and hemicellulolytic activity, and MNP (manganese peroxidase) productivity (Tangthirasunun & Poeaim, 2022).

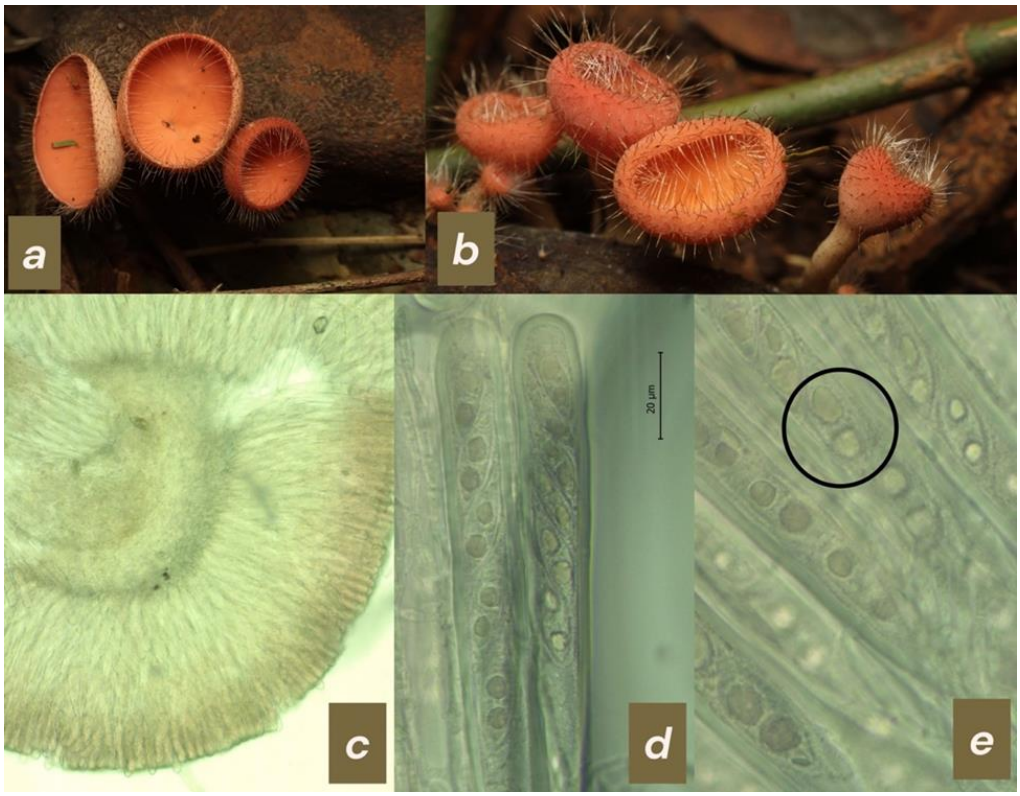

Fig.2. Morphology of *Cookeina tricholoma*. a-b: Apothecia growing on a substrate (branch); c: Cross-section of an apothecium; d: Ascus; e: Ascospores

***Agaricus* sp.**

Synonyms:

Amanita Dill. ex Boehm., Ludwig Defin. Gen. Pl.: 490 (1760)
Hypophyllum Paulet (1808)
Pratella Pers. ex Gray, A natural arrangement of British plants 1: 626 (1821)
Psaliota (Fr.) P. Kumm. (1871)
Agaricus tr. Psalliota Fr., Systema Mycologicum 1: 280 (1821)
Psalliota (Fr.) P. Kumm., Der Führer in die Pilzkunde: 23, 72 (1871)
Psalliota sect. Psalliota (Fr.) P. Kumm.: 72 (1871)

The fruiting body has a cap, gills (lamellae), stipe (stalk), and an annulus on the stipe. The cap, with a diameter of 4-5 cm, is white with brownish spots, ranging from flat to convex, and is finely scaly across its surface (Figure 3a). The cap margin is slightly serrated with an entire edge. The free gills are pink, with a hymenophore type accompanied by white powder (Figures 3b, c). The stipe is slightly enlarged at the base, white to brownish in color. The fruiting body length ranges from 5-6 cm, measured from the top of the cap to the end of the stipe. The annulus is located in the inferior position, attached to the stipe in a central position, and the type of attachment to the substrate is strigose. The fruiting body has a soft, cartilaginous texture and lacks a distinctive odor.

Fig.3. Morphology of *Agaricus* sp. a. Cap of *Agaricus sp.*; b. Stipe with annulus; c. Closed hymenophore; d. Septate hyphae from stipe; e. Spores from lamella; f. Cystidia from cap; g. Pileipellis from cap. Bar d-g = 20 µm.

Microscopically, the hyphae are septate (Figure 3d), the spores are ellipsoid, smooth, brown, and thick-walled (Figure 3e). Cystidia have a long cylindrical base (Figure 3f). The pileipellis consists of cylindrical, brown, smooth hyphae that narrow slightly at the septa (Figure 3g).

The specimen found in this study shows gills (lamellae) still covered by a universal veil, a remnant of basidiocarp development. *Agaricus* is a genus with complex species, requiring complete morphological characteristics for taxonomic determination. Therefore, morphological identification can only be performed up to the genus level. He et al. (2017) reported that *Agaricus* is a genus of saprophytic fungi characterized by free lamellae that are white to pink when young, turning brown as they mature, the presence of an annulus on the stipe, and brown to dark brown spore prints.

***Cyathus striatus* (Huds.) Willd., Florae Berolinensis Prodromus: 399 (1787)**

Synonyms:

Peziza hirsuta Schaeff., Fungorum qui in Bavaria et Palatinatu circa Ratisbonam nascuntur Icones 4: 124, t. 178 (1774)

Cyathus hirsutus (Schaeff.) Sacc., Sylloge Fungorum 17: 214 (1905)

Peziza lentifera L., Species Plantarum: 1180 (1753)

Cyathia lentifera (L.) V.S. White, Bulletin of the Torrey Botanical Club 29: 264 (1902)

Cyathus laevis Willd., Florae Berolinensis Prodromus: 399 (1787)

Peziza hirsuta Schrank, Baierische Flora 2: 625 (1789)

Nidularia hirsuta (Schrank) Sowerby, Coloured Figures of English Fungi 1: pl. 29 (1797)

C. striatus is vase-shaped (Figure 4a) and has hairy outer parts. The outer part and hairs are brown. The inner part is grooved and white to brownish (Figure 4c). Inside the bowl, there are peridioles (Figure 4b) resembling eggs, which contain spores. The observed *C. striatus* is 1 cm x 0.6 cm. The spores are oval to ellipsoidal with a central groove (Figure 4e). The spores are colorless or hyaline. The hyphae are aseptate and overlap (Figure 4d).

Identification based on the *Cyathus* genus key from Indonesia (Hastuti, 2004) confirmed the specimen in this study as *C. striatus*. This species has a tunicate, folded inner and outer parts, a peridium measuring 8-11 x 7-9 mm, and a fibrillated mouth. *C. striatus* has a bird's nest or bowl-like fruiting body with a narrowed base. The inner and outer parts are grooved, with the inner surface being smooth and shiny. *C. striatus* has peridioles (egg-like structures) containing spores (Hastuti, 2004). Currently, information on the presence and distribution of *Cyathus* in Indonesia is still very limited, and the only comprehensive report on this fungus in Indonesia is Hastuti's (2004) study.

There are no reports regarding the edibility of *Cyathus* mushrooms, but they have pharmaceutical benefits. Research by Wey et al. (2023) demonstrated that *C. striatus* has neurotropic and anti-inflammatory properties. Another study mentioned that this mushroom also exhibits anticancer activity against pancreatic cancer cells both in vitro and in vivo, indicating significant potential in the pharmaceutical field (Shervit et al. 2021). *Cyathus* is also known as a source of antibiotic compounds. New antibiotics, Pyristriatins A and B were discovered in the fruiting bodies of *Cyathus striatus* (Richter et al. 2016), along with Striatins found earlier (Anke et al. 1977).

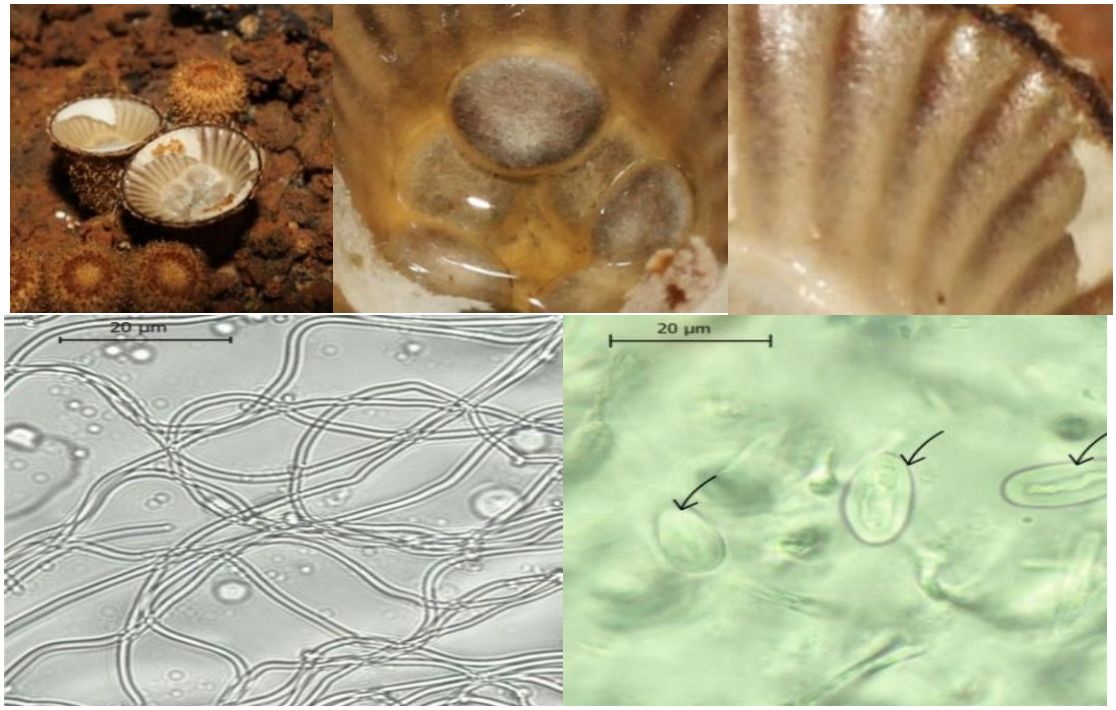

Fig.4. Morphology of *Cyathus striatus*. a. Fruiting body; b. Peridiole; c. Peridium; d. Hyphae; e. Spores

***Marasmiellus* sp.**
Synonym: *Agaricus candidus*
NatureServe Unique Identifier: Element_Global.2.124154 (Philips, 1991)

The specimen found in the IPB campus forest grows in clusters (Figure 5a). The cap has a diameter of 1-4 cm, ranging from broadly convex to nearly flat, with a smooth, somewhat wrinkled texture and straight margins. It is white with a slightly yellowish center (Figure 5b). The gills are attached to the stipe, slightly yellowish, thin, and soft (Figure 5c). The stipe is cylindrical, measuring 1-8 cm in length and up to 2 mm thick, tapering from top to base. It is dry and hollow, yellow to white, with a dark brown or nearly black base, and is smooth, directly attached to the substrate (Figure 5c). The specimen lacks a distinctive odor. The spores are elongated to oval (Figure 5d), hyphae are non-septate and thin-walled (Figure 5e), and the basidia are arranged in a circular flower-like pattern (Figure 5f).

The specimen collected in this study is closely related to *Marasmiellus* sect. *Marasmiellus* based on the identification key for *Marasmiellus* from Java and Bali written by Retnowati (2012). However, the pileipellis characteristics of the collected sample have not been observed, leaving some key features undescribed. *Marasmiellus* belongs to the Marasmioid group and includes various complex species with close relations not only within species but also among closely related genera (Retnowati, 2004). For future research on *Marasmiellus* from this study site, completing the microscopic morphological features and incorporating molecular approaches are necessary to confirm the taxonomic identity of this complex species, which is highly influenced by morphological plasticity (Putra et al., 2022b).

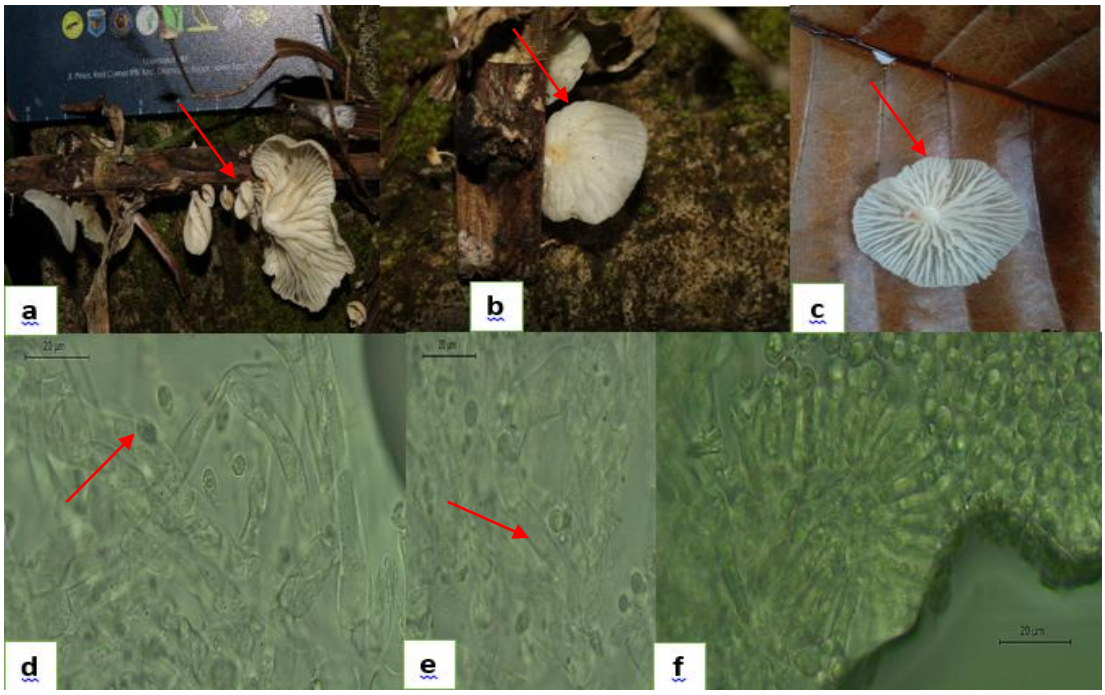

Fig.5. Morphology of *Marasmiellus* sp. a) Fruiting body; b) Cap; c) Gills; d) Spores; e) Hyphae; f) Hymenial basidia

***Lepista sordida* (Schumach.)**
Synonym:
Agaricus sordidus Schumach., Enumeratio Plantarum, in Partibus Sællandiae Septentrionalis et Orientalis Crescentium 2: 341 (1803)
Tricholoma sordidum (Schumach.) P. Kumm., Der Führer in die Pilzkunde: 134 (1871)
Rhodopaxillus sordidus (Schumach.) Maire, Annales Mycologici 11 (4): 338 (1913)
Melanoleuca sordida (Schumach.) Murrill, Mycologia 6 (1): 3 (1914)
Lepista nuda var. *sordida* (Schumach.) Maire, Étud. synth. genre Tricholoma (1916)
Lepista domestica Murrill, Mycologia 7 (2): 106 (1915)
Gyrophila sordida (Schumach.) Quél., Enchiridion Fungorum in Europa media et praesertim in Gallia Vigentium: 18 (1886)

Lepista sordida is a saprobic fungus that grows on the ground (Figure 6a). The fruiting body has a pale purple/violet pileus with a depressed center (Figure 6b). The edge of the cap is finely serrated, with a diameter of 5-6 cm. The adnate gills are a darker purple than the pileus (Figure 6c). The stipe is cream-colored, smooth (Figure 6c), with overlapping pileipellis (Figure 6d), clavate basidia (Figure 6e), and ellipsoidal, hyaline spores (Figure 6e).

Previous reports of *L. sordida* in Indonesia come from Cibinong, West Java (Retnowati, 2019) and Tasikmalaya, West Java (Putra et al. 2022b). This study marks the third report of this species in Indonesia. Morphologically, the species is characterized by a purple cap with a dirty brown layer, deriving its name from the word *sordidus*, meaning dirty (Putra et al. 2022b). The dimensions of the fruiting body and spores from the IPB campus forest specimen match the reports by Retnowati (2004) and Putra et al. (2022b). *Lepista sordida* is considered edible (Terashima and Fujie, 2005). However, there is no

information on its utilization as a food source in Indonesia or at the study site. Several studies have proven that *L. sordida* has various benefits, one of which is its antimicrobial properties. Research by Acharya et al. (2019) demonstrated that this mushroom can inhibit several pathogenic bacteria and possesses antioxidant activity. Research by Nurhayat et al. (2023) demonstrated that the major volatile compound in *L. sordida*, identified using GC-MS, is 4-O-Methylmannose. This compound has potential as an antitoxic, antimicrobial, anti-protozoal (Leishmania), and anti-neoplastic agent.

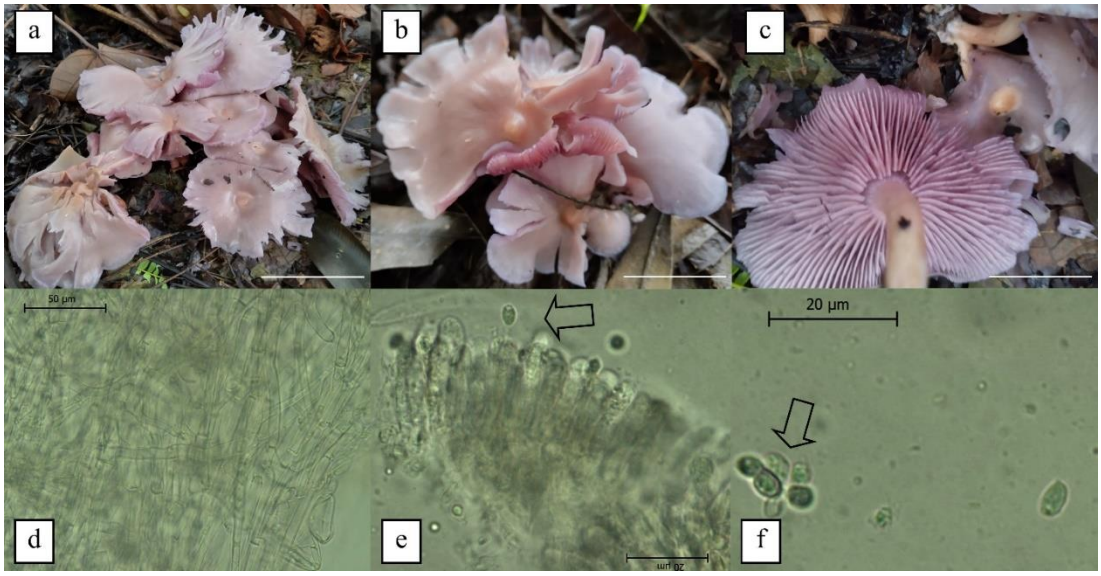

Fig.6. Morphology of *Lepista sordida.* **a)** Fruit body on substrate; **b)** Pileus with umbo;**c)** Lamellae; **d)** Pileipellis; **e)** Basidia with basidiospores; **f)** Basidiospores.

CONCLUSION

This research successfully described and identified five unique fungi in the IPB University campus forest area. Each fungus has distinct characteristics. The five identified species are: *Cookeina tricholoma*, *Agaricus sp.*, *Cyathus striatus*, *Marasmiellus sp.*, and *Lepista sordida*. Three of these (*C. tricholoma*, *L. sordida*, and *Marasmiellus sp.*) are edible wild mushrooms. Four of the fungi belong to the phylum Basidiomycota, while one (*C. tricholoma*) belongs to the phylum Ascomycota. This research contributes to the diversity data of fungi and their distribution information in Indonesia

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REFERENCES

Acharya K, Ghosh S, & Biswas R. (2019). Chemical composition and bioactivity of methanolic extract obtained from Lepista sordida. *Brazilian Journal of Pharmaceutical Sciences, 55*, e17824. https://doi.org/10.1590/s2175-97902019000217824

Anke T, Oberwinkler F, Steglich W, & Hofle G. (1977). The striatins-new antibiotics from the basidiomycete Cyathus striatus (Huds. ex Pers.) Willd. *The Journal of*

Antibiotics, *30*(3), 221-225. DOI https://doi.org/10.7164/antibiotics.30.221

Dijk HV, Onguene NA, Kuiper TW. (2003). Knowledge and utilization of edible mushroom by local population of the rain forest of South Cameroon. *Ambio*.32 19-23. DOI: https://doi.org/10.1579/0044-7447-32.1.19

Ekanayaka A, Hyde Kd, Zhao Q. (2016). The Genus *Cookeina*. *Mycosphere.* 7:1399–1413. DOI: 10.5943/mycosphere/7/9/13

Fung, S.-Y., & Tan, C.-S. (2017). The Bioactivity of Tiger Milk Mushroom: Malaysia's Prized Medicinal Mushroom. *Medicinal Plants and Fungi: Recent Advances in Research and Development*, 111–133.

Hastuti L. (2004). A Revision of Genus Cyathus (Nidulariaceae) In Indonesia. [Tesis]. Institut Pertanian Bogor.

Hawksworth D, Lűcking R. (2017). Fungal diversity revisited: 2.2 to 3.8 million species. *Microbiology Spectrum*. 5 (4): 79-95. DOI: 10.1128/microbiolspec. FUNK-0052-2016.

He MQ, Chen J, Zhou JL, Ratchadawan C, Hyde KD, Zhao RL. (2017). Tropic origins, a dispersal model for saprotrophic mushrooms in Agaricus section Minores with descriptions of sixteen new species. *Sci Rep*. 7: 1-31. doi: 10.1038/s41598-017-05203-5.

Hermawan R, Putra IP, Amelya MP. (2022). *Cookeina tricholoma* of West Java (Indonesia) Based on Morphological and Molecular Identification. *Philippine Journal of Science*. Vol. 151 No. 5.

LIPI. (2019). *Status keanekaragaman hayati Indonesia: kekayaan jenis tumbuhan dan jamur Indonesia*. Ed: Retnowati A, Rugayah, Rahajoe JS, Arifiani D. Jakarta : LIPI Press.

Moreno RB, Ruthes AC, Baggio CH, Vilaplana F, Komura DL, Iacomini M. (2016). *Carbohydrate Polymers*. 5-31.

Nurhayat OD, Putra IP, Sibero MT, Karimah SN, Anita SH, Yanto DHY, & Kristanto MA. (2023). First identification of potential bioactive compounds from ethanol extracts of Lepista sordida from Indonesia. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1271, No. 1, p. 012058). IOP Publishing. DOI 10.1088/1755-1315/1271/1/012058

O'Dell T, Lodge D, Mueller GM. (2004). Approaches to sampling macrofungi. *Biodiversity of Fungi: Inventory and Monitoring Methods*. 163-168.

Patel DK, Dutta SD, Ganguly K, Cho SJ, Lim KT. (2021). Mushroom-derived bioactive molecules as immunotherapeutic agents: A review. *Molecules*. 26(5):1359.

Putra, IP, Amelya, MP, Nugraha NH, Zamia HZ. (2019). Notes of Some Macroscopic Fungi at IPB University Campus Forest: Diversity and Potency. *Biota: Biologi dan Pendidikan: 12(2).*

Putra IP. (2020). Record on macroscopic fungi at IPB university campus Forest: Description and potential utilization. *IJOSE*. 4 (1):1-11.

Putra IP, Amelya MP, Veronica S, Kurnianto MS. (2020). Fantastic Fungi Around Us: A Case Study of IPB University Campus Forest. *Jurnal Pena Sains*. Vol. 7:No. 2.

Putra IP. (2021). Panduan karakterisasi jamur makroskopik di Indonesia: Bagian 1- Deskripsi ciri makroskopis. *Jurnal Penelitian Kehutanan Wallacea.*10(1):25-37.

Putra IP, Nurdebyandaru N, Amelya MP, Hermawan R. (2022a). Review: Current Checklist of Local Names and Utilization Information of Indonesian Wild Mushrooms. *Journal of Tropical Biodiversity and Biotechnology*. 7(3): jtbb71407.

Putra IP, Hermawan R, Sibero MT, Sari AA, Nurhayat OD. (2022b). Morphological and Molecular Study of Lepista sordida in Indonesia. *Philippine Journal of Science*. 151(4): 1333–1336

Retnowati, A. (2019). Newly Recorded Lepista sordida (Schumach.) Singer (Agaricales Tricholomataceae) for Indonesia. Floribunda, 6(3): 81-84.

Retnowati A. (2012). Taxonomic study of the genus *Marasmiellus* Murrill in Java and Bali. UI Press, Jakarta.

Richter C, Helaly SE, Thongbai B, Hyde KD & Stadler M. (2016). Pyristriatins A and B: Pyridino-cyathane antibiotics from the Basidiomycete Cyathus cf. striatus. *Journal of natural products*, *79*(6), pp.1684-1688. https://doi.org/10.1021/acs.jnatprod.6b00194

Sharvit L, Bar-Shalom R, Azzam N, Yechiel Y, Wasser S, & Fares F. (2021). Cyathus striatus extract induces apoptosis in human pancreatic cancer cells and inhibits xenograft tumor growth in vivo. *Cancers*, *13*(9), 2017. DOI https://doi.org/10.3390/cancers13092017

Tan X, Mi F, Zhang Y, He X, Cao Y, Wang P, Xu J. (2015). Diversity, population genetics, and evolution of macrofungi associated with animal. *Mycology*. 6 (2): 94- 109. DOI: 10.1080/21501203.2015.1043968.

Tangthirasunun N. & Poeaim S. (2022). Studies on the Rapid and simple DNA extraction Method, Antibacterial Activity and enzyme Activity involved in Plant Biomass Conversion by Cookeina sulcipes and C. tricholoma (Cup Fungi). *Journal of Pure & Applied Microbiology*, *16*(4). DOI: 10.22207/JPAM.16.4.58

Terashima Y, Fujiie A. (2005). Development of a fairy ring caused by *Lepista sordida* on Zoysiagrass over an eight-year period. *International Turfgrass Society Research Journal.* Vol.10**:**251–257.

Usman Muhammad, Murtaza G, Nutritional AD. (2020). Medicinal, and Cosmetic Value of Bioactive Compounds in Button Mushroom (Agaricus bisporus). *Applied Sciences*: 11 (13):5943.

Wei J, Ye MY, Wang ZX, Zhang YL, Hu XS, Hui HP, Liu YT & Qi J. (2023). Molecular properties, structure,

neurotrophic and anti-inflammatory activities of cultured secondary metabolites from the cultures of the mushroom Cyathus striatus CBPFE A06. *Natural Product Research*, pp.1-6. https://doi.org/10.1080/14786419.2023.2273911